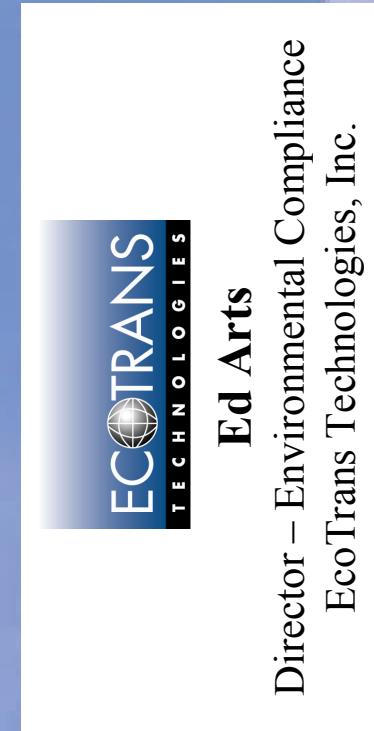


K9® Auxiliary Power Unit (APU)

Locomotive Idle Reduction System:

Opportunities for Fuel Savings, Emission Reductions and Emissions Trading

Michigan Clean Fleet Conference
March 22, 2006 Detroit, Michigan



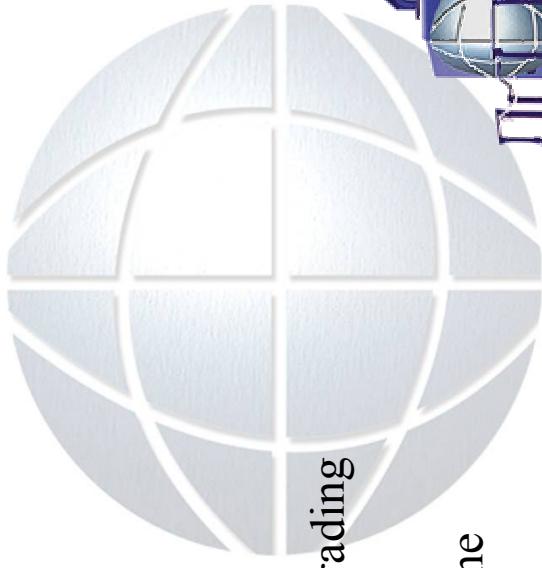
Presentation Outline



- K9® APU Technology
 - Overview of CSX Transportation
- Fuel Savings
 - Ontario Emissions Trading System
- Noise Reduction
 - Standard Method
- Emissions Reductions
 - Registering Credits
 - Potential reductions
- Transboundary Air Pollution
 - Ontario Credit Eligibility Zone
- Overall benefits

Presentation Outline

- APU Technology Description
- Operating Characteristics
- Fuel Savings
- Noise Reduction
- Emissions Reductions
- The Concept of Emissions Trading
- Transboundary Air Pollution
- Ontario Credit Eligibility Zone



Technology Description



- The K9® APU system consists of an auxiliary diesel engine/genset and an engine shutdown timer (EST). Together, these two components provide for a significant reduction in main engine idle time.
- The heart of the K9® APU consists of a Kubota V2003-T-B diesel engine mated to a 60 hertz 240 volt single phase 16KW generator set.



Technology Description



- The system uses a water/coolant heat exchanger for APU engine cooling and main engine heating. Locomotive water pump, locomotive lube oil pump, and a fuel supply and return are part of the system.
- Additional heaters are included, 9KW for water, and 1.5 KW for oil. Locomotive oil and water are re-circulated whenever the APU runs. Locomotive batteries also receives a trickle charge whenever the APU runs. The APU always receives a trickle charge from the Locomotive batteries.



Technology Description



- The APU has its own engine oil system, with a 15 gallon sump. This arrangement allows for 2 year oil change intervals.
- The APU is designed to start up and shut down automatically in response to locomotive water temperature, locomotive batteries, or operator demand. No operator action is required.
- The APU can be used to power common household equipment such as air conditioners and heaters. This flexibility permits locomotive shutdown while maintaining crew comfort.
- The APU will attempt to start five times before it issues an alarm. It will also self-protect and issue an alarm for high temperature, low oil pressure, overspeed, or overcrank.
- The main engine shut down timer (EST), forces the main engine into a shutdown after a period of idle activity. Shortly after a shutdown, locomotive lights automatically drop out to conserve batteries.



Operating Characteristics



Protect Your Investment



Operating Characteristics

If the following conditions exist, the EST will shutdown the main engine:

- APU has not issued an alarm or fault
- APU has a healthy 12 volt battery
- APU mode selector is in either “autocycling” or continuous run
- APU emergency stop is pulled out
- Idle exceeds 30 minutes (reverser centered for 30 minutes, no activity in trainline.)
- Prior to a forced shutdown, the EST will issue three beeps, alerting an operator that a shutdown is approaching.
- Two minutes following a shutdown, the lights will drop off of the battery. A reset switch in the cab allows for re-energization of lights for two minutes.



Operating Characteristics

- During the shutdown, the APU will remain dormant until it receives a signal to start.
- The APU has two inputs to start
 1. It will start on temperature, warm up, and then energize heaters and the battery charger when main engine water temperature drops to less than 60 degrees F. It will cool down and shutdown when water temperature exceeds 100 degrees F.
 2. It will also start on low main engine battery voltage <65 V, this will also energize heaters (if necessary) and the battery charger. It will cool down and shutdown after two hours.
- To restart the locomotive, simply follow normal starting procedures for the locomotive engine class. The APU will automatically shutdown and the EST timer will reset for the next shutdown.

Note: If the APU is not “healthy” as described above, the main engine will not shutdown.



Fuel Benefits

ECOTRANS
TECHNOLOGIES[®]



Rescue Your Fuel Budget



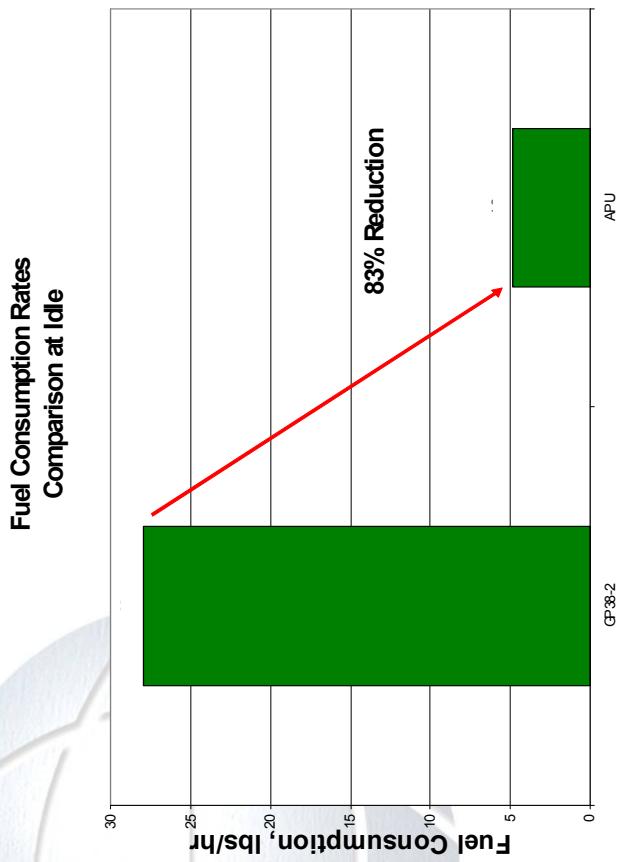
Fuel Benefits

The APU saves fuel and lube oil

- With the APU we can achieve an average fuel consumption reduction of 83%. In fact, the APU does not run all the time when the main locomotive engine is shutdown, hence saving even more fuel!

- In addition, less locomotive idling means less lube oil consumption and less engine wear and tear.

Idle Fuel Savings (test data from Southwest Research Institute)



Fuel Savings

- The amount of fuel savings varies depending on the locomotive duty cycle, weather conditions and battery voltage. Typical fuel savings range between 14,000 gal/yr (for Line-Haul) and 23,000 gal/yr (Switcher).

- For an average diesel price of \$1.39/gallon, this translates to \$19,460 to \$31,970 in fuel savings per locomotive per year!

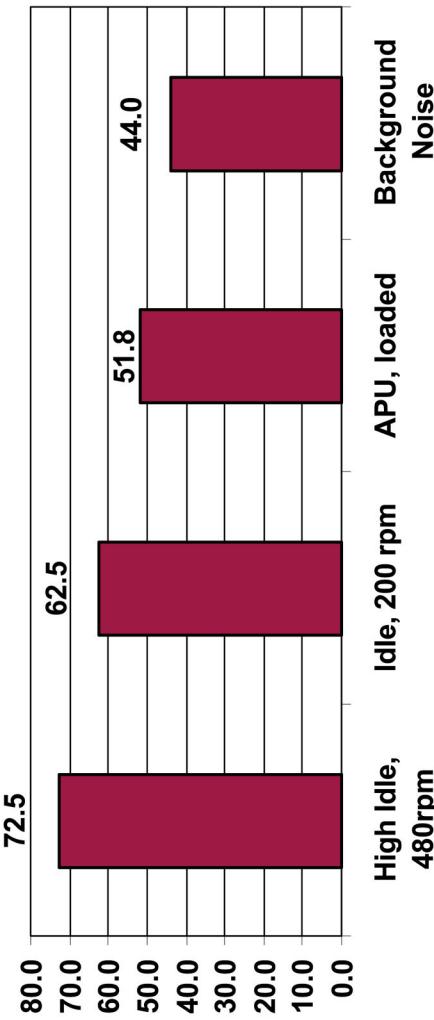
- Regardless, the payback period of the APU is usually less than a year!



Noise Level Reduction

- As an added benefit, the APU minimizes noise pollution that is usually associated with rail yards.

**Main Engine vs APU Noise Levels (decibels) at 100ft.
Engineer's Side**



- Noise generated from the APU, in normal operating mode with the locomotive carbody doors shut is virtually indistinguishable from normal background noise at a distance of 100 feet.



Emissions Reductions



- By reducing locomotive engine idling, locomotive emissions are reduced by a large degree. This has positive effects on improving air quality.



- Independent laboratory testing by Southwest Research Institute demonstrated large reductions in NOx, HC, CO and PM emissions.



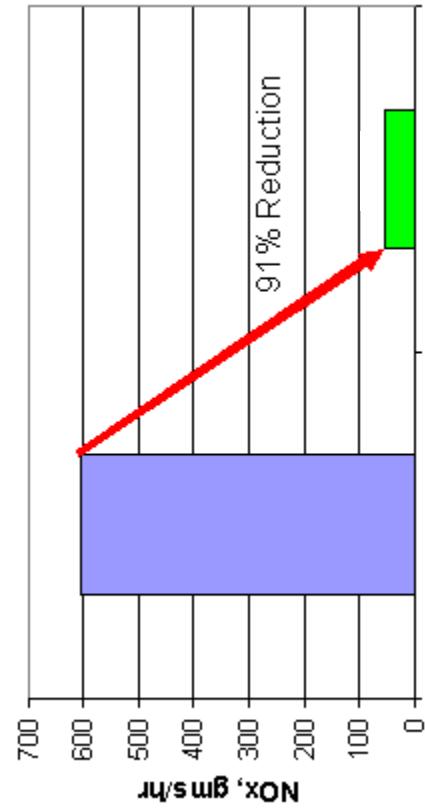
Idle Emissions Reductions



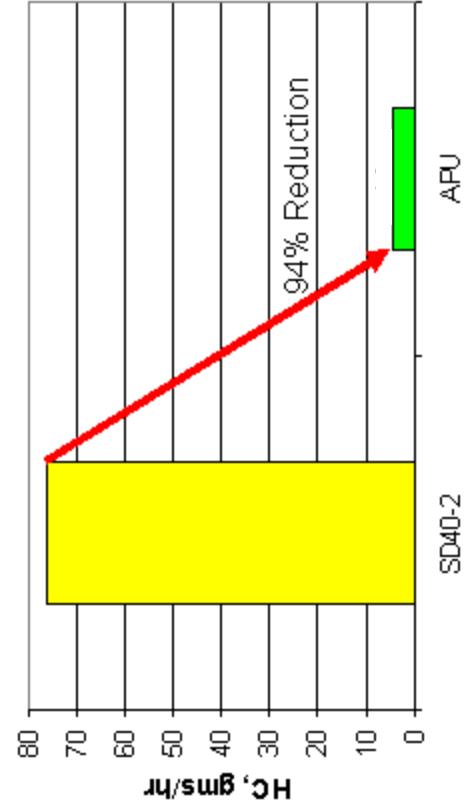
(SD40-2 16-645E3 vs APU)

test data from Southwest Research Institute

Nox Emission Rates
Comparison at Idle



Hydrocarbon Emission Rates
Comparison at Idle



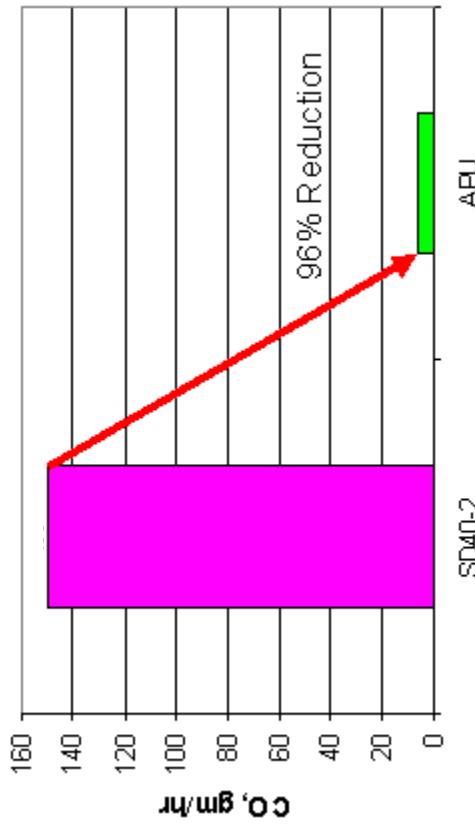
Idle Emissions Reductions

(SD40-2 16-645E3 vs APU)

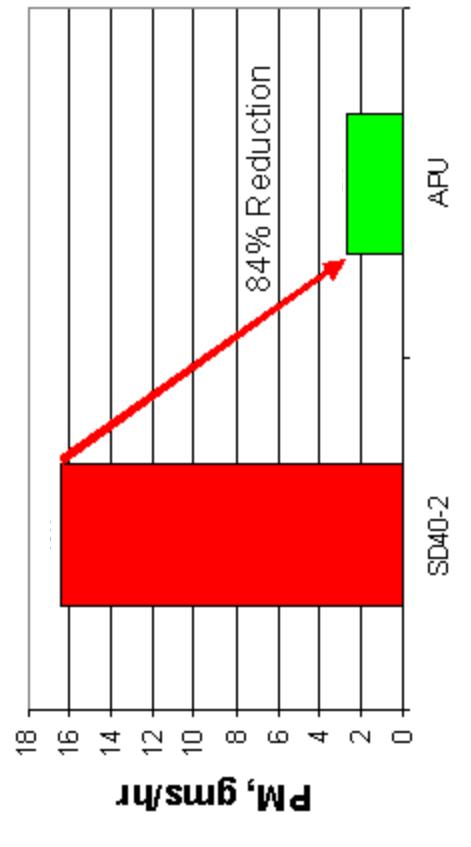
test data from Southwest Research Institute



**Carbon Monoxide Emission Rates
Comparison at Idle**



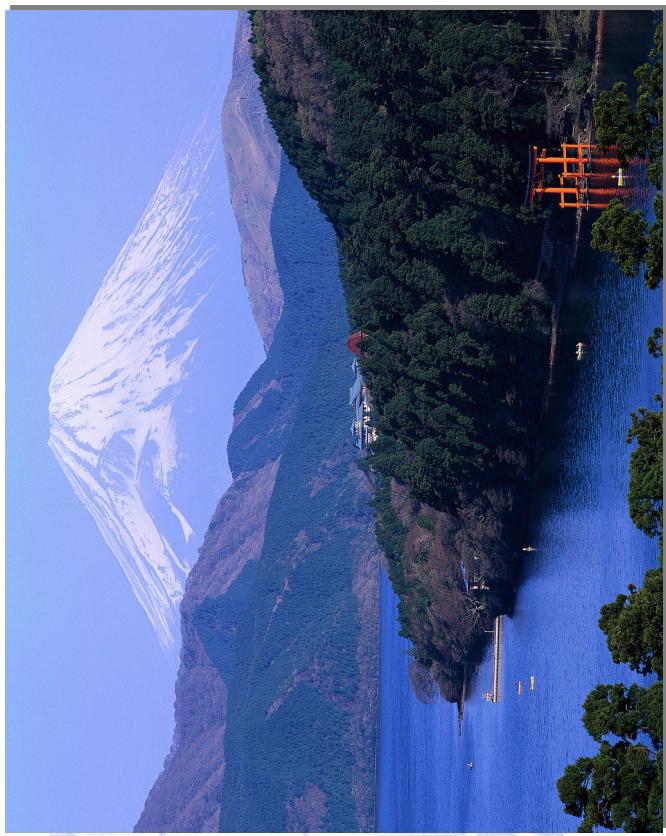
**Particulate Matter Emission Rates
Comparison at Idle**



Environmental Excellence



- Reducing locomotive engine idling has tremendous effects in improving air quality in North America.
- The APU can be installed as part of an emission control package certified to meet the EPA's *Tier Zero* standards.
- Environmental protection cannot be ignored in today's economy. Being environmentally-responsible is not only socially beneficial but also economically rewarding!

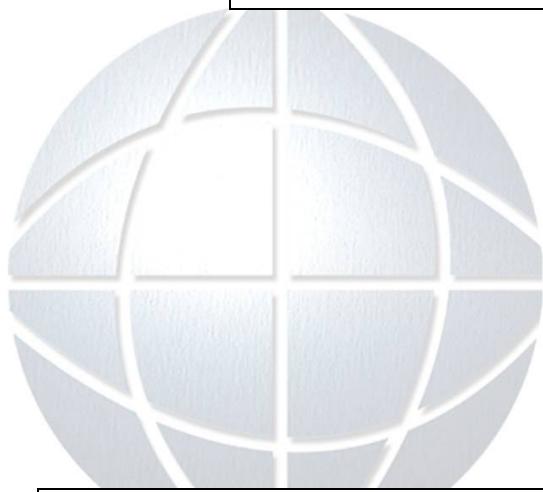


The Concept of Emissions Trading

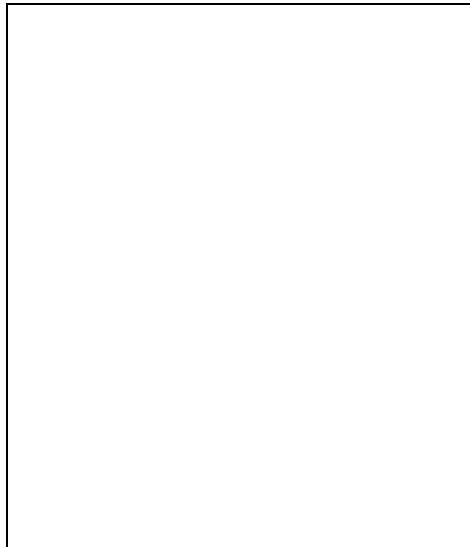
- Emissions Trading is not a new concept. It was developed by environmental economists in the 1970's. It is used in the US as part of the EPA's Acid Rain Program.
- The theory behind emissions trading is emissions reductions are achieved by the least possible costs. It also creates an economic incentive for companies to reduce their emissions voluntarily
- The following slides explain the concept through a simple example.



Example: two capped facilities



Facility A

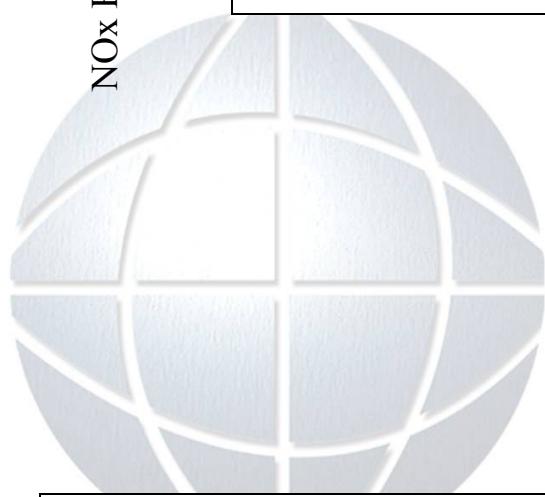


Facility B

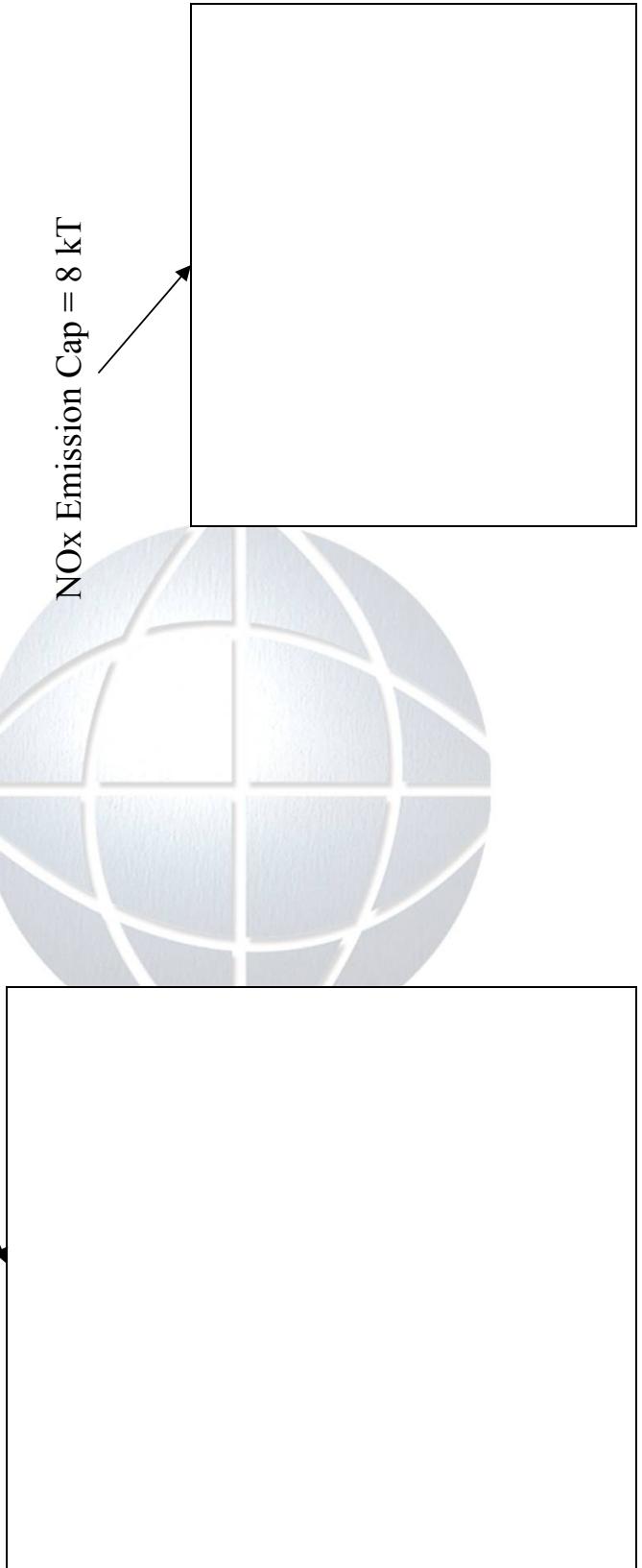




NOx Emission Cap = 10 kT



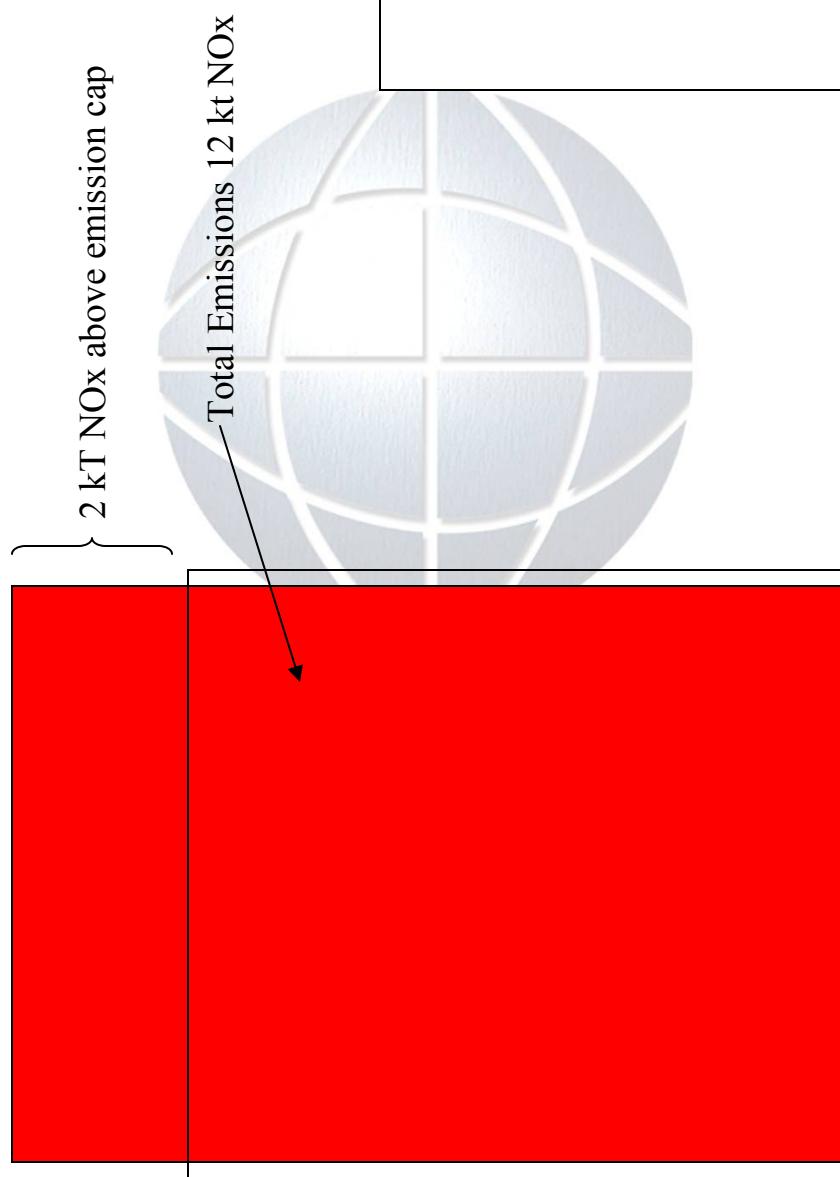
NOx Emission Cap = 8 kT



Facility A

Facility B

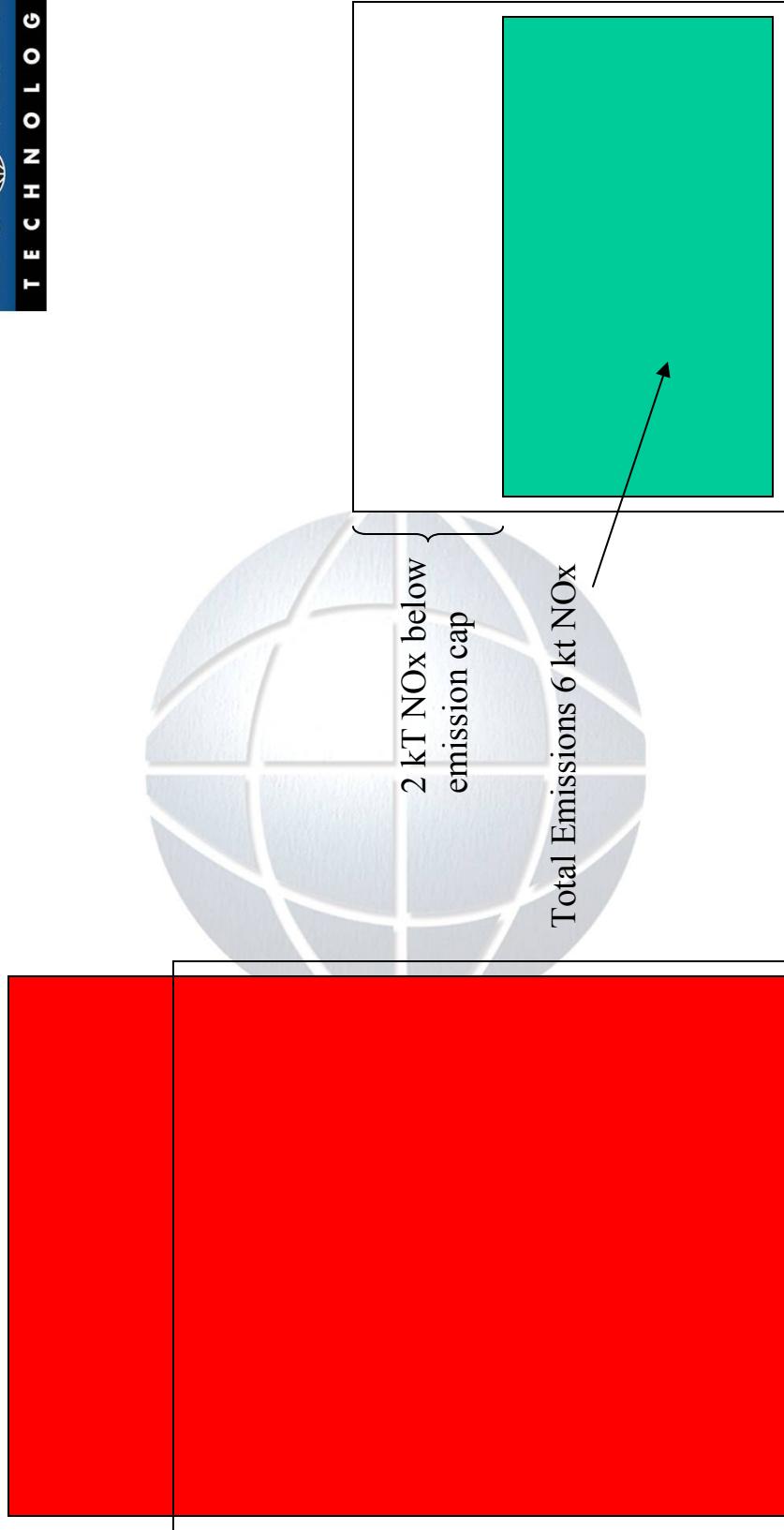


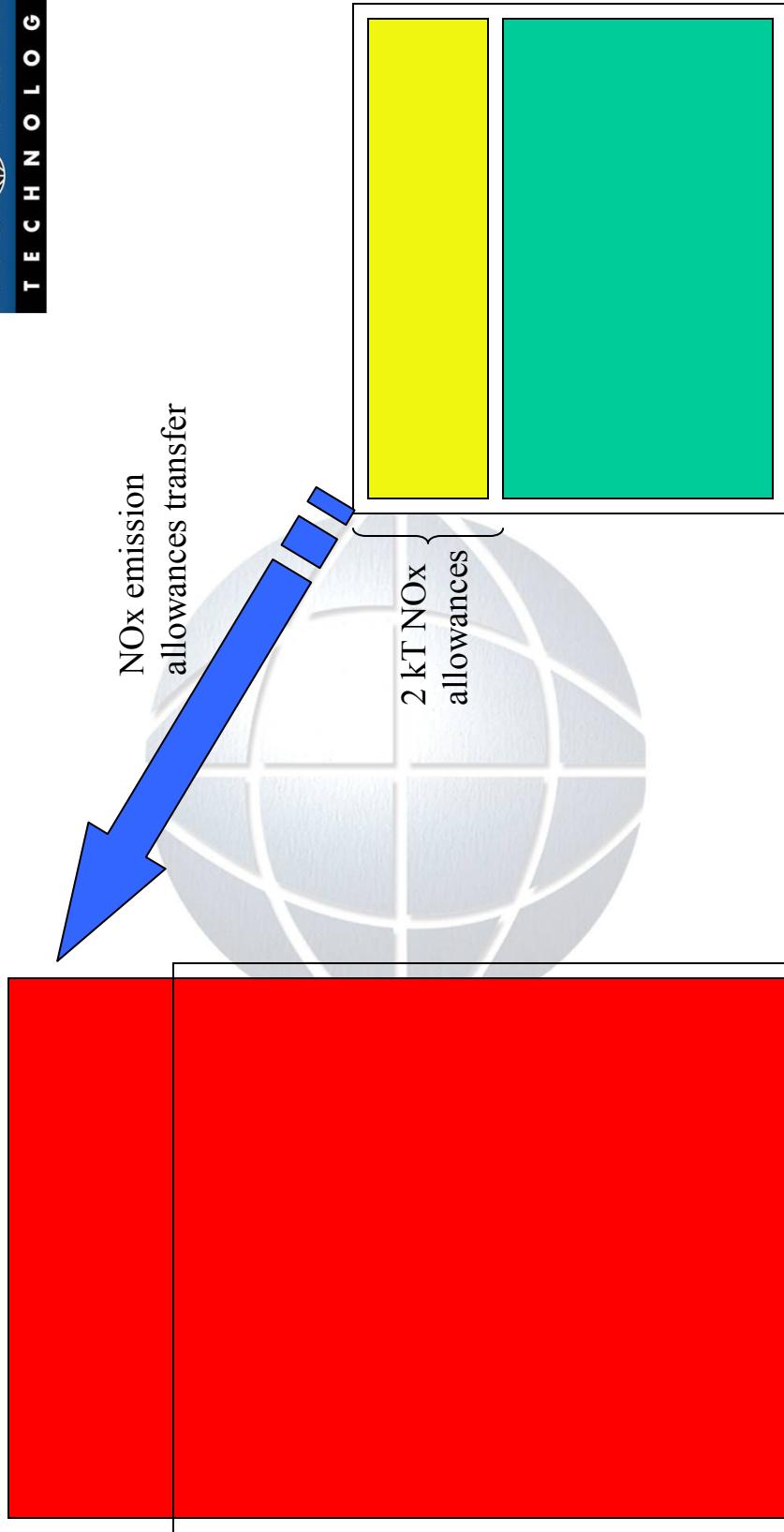


Facility A

Facility B



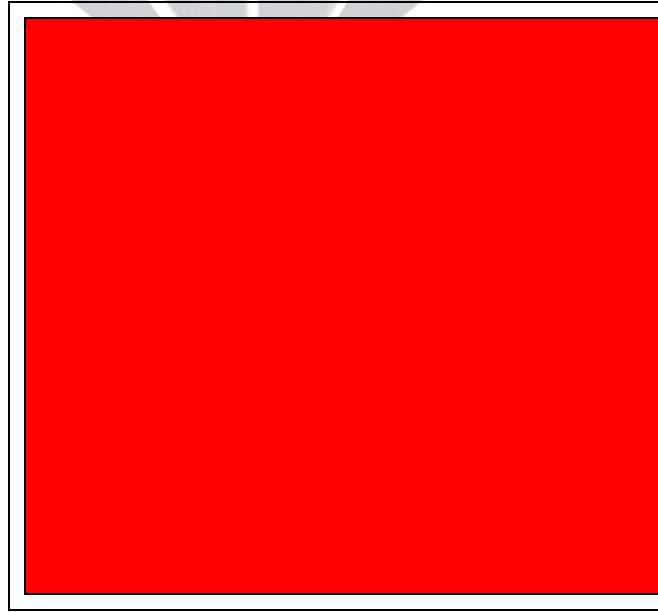
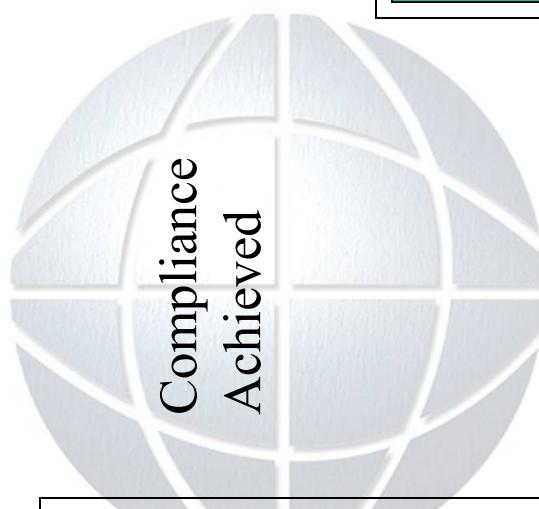




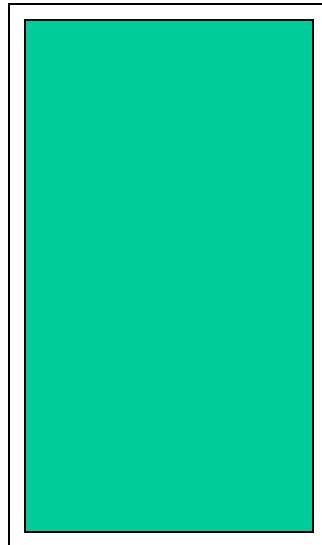
Facility B

Facility A





Facility A



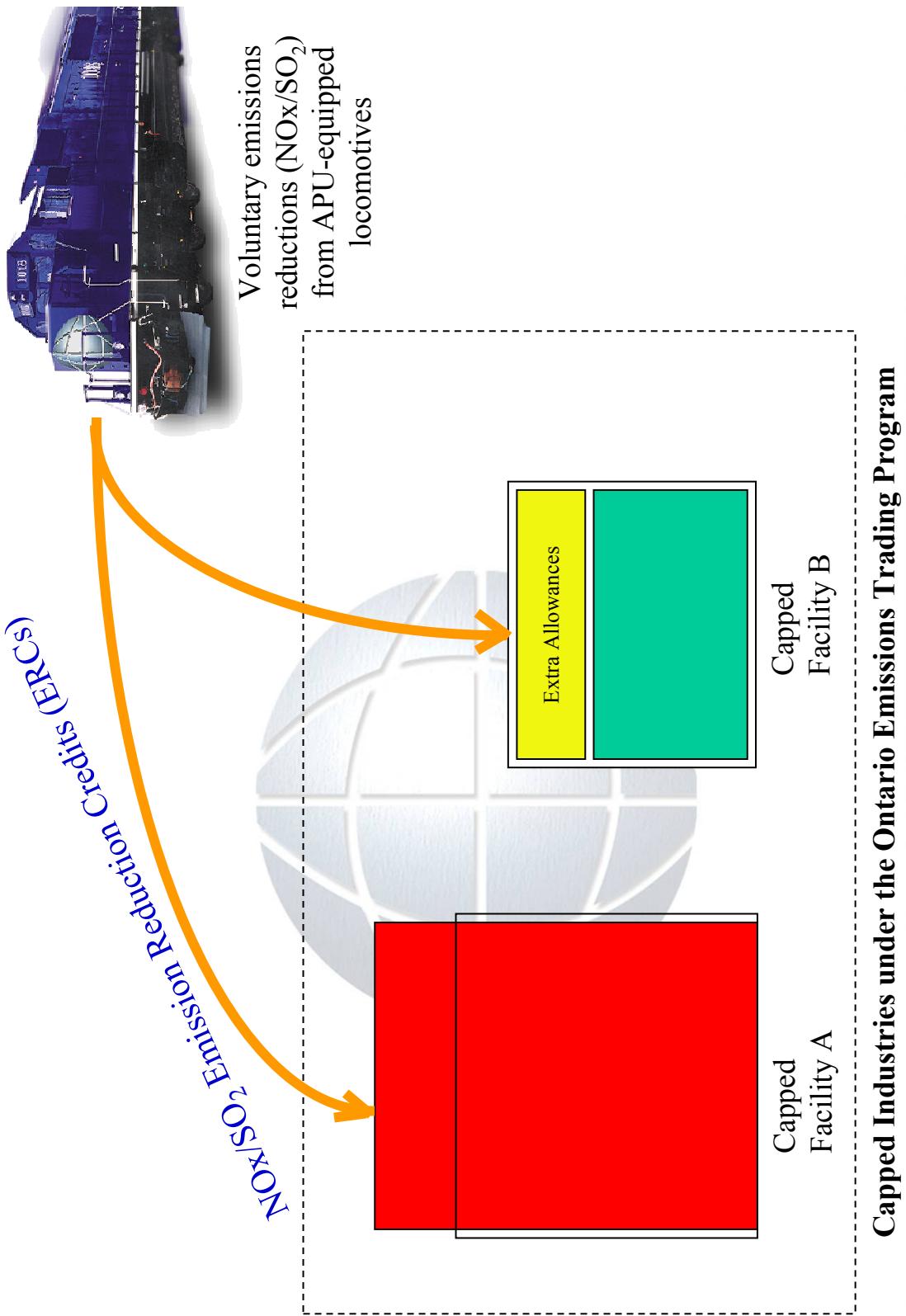
Facility B

Emission Reduction Credits



- Non-capped emitters can voluntarily reduce their emissions and register these emission reductions as “[Emission Reduction Credits \(ERCs\)](#)” that can be sold to capped industries that are in need of compliance.
- As will be explained later, Standard Method A.6 of the Ontario Emissions Trading Code allows for the creation of ERCs from the installation of an idle reduction system on mobile sources. The **K9® APU** meets the eligibility criteria for SM A6.





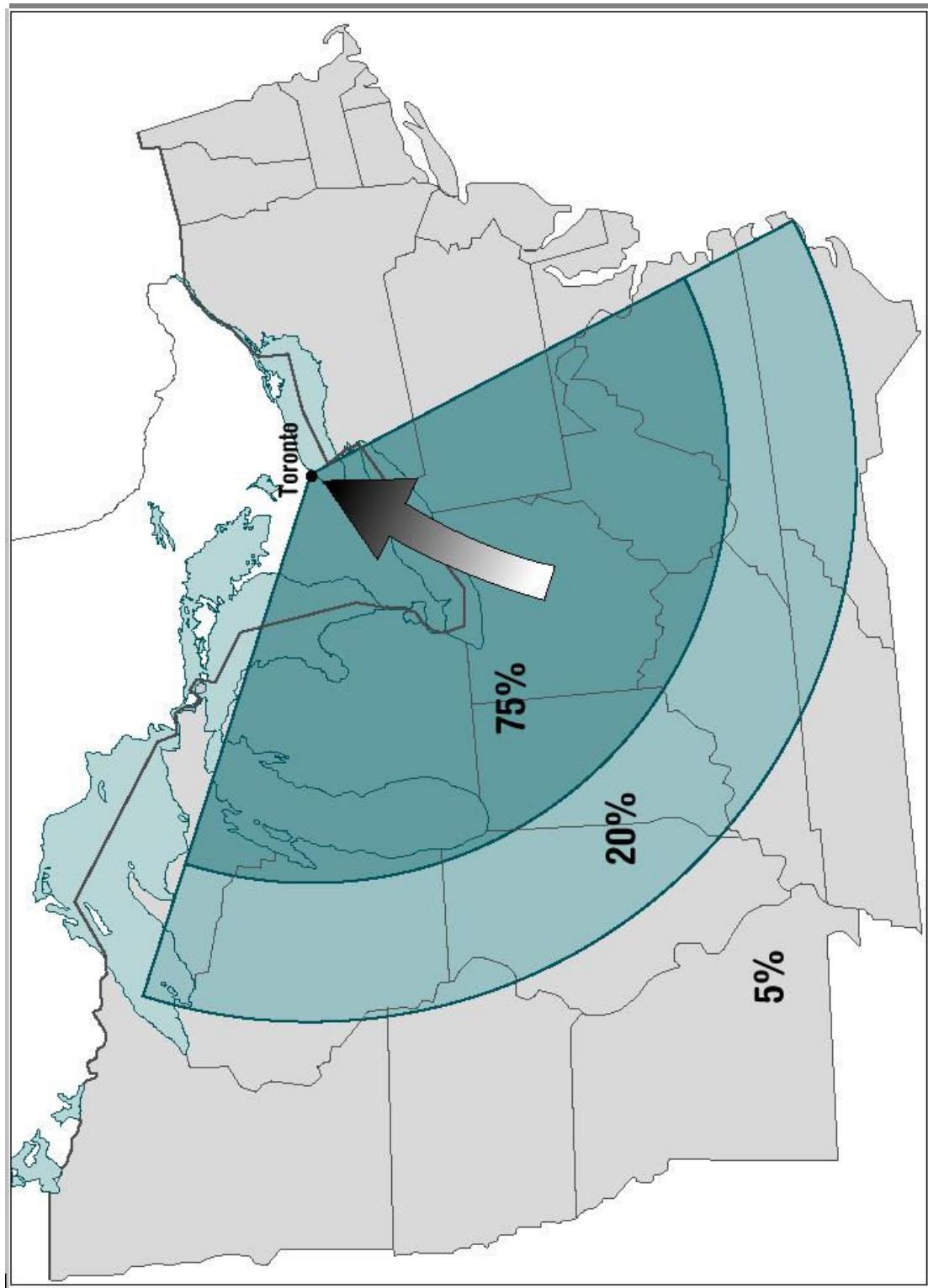
Transboundary Air Pollution

- Emissions do not know borders. Once emitted, NOx and SO2 mix in the atmosphere and travel several thousands of kilometers from their point of origin. Hence, smog is a regional problem, particularly in the Great Lakes region.
- There have been numerous studies by the Ontario Ministry of the Environment (MOE) that shows that a significant portion of air pollution in the province originates from point sources in the US.
- In certain areas in Southwestern Ontario, the contribution of transboundary pollution from the US reaches as much as 90% !



U.S. Source Regions of Transboundary Ozone into Ontario

(Source: Ontario Ministry of the Environment, 1999)



Ontario Credit Eligibility Zone

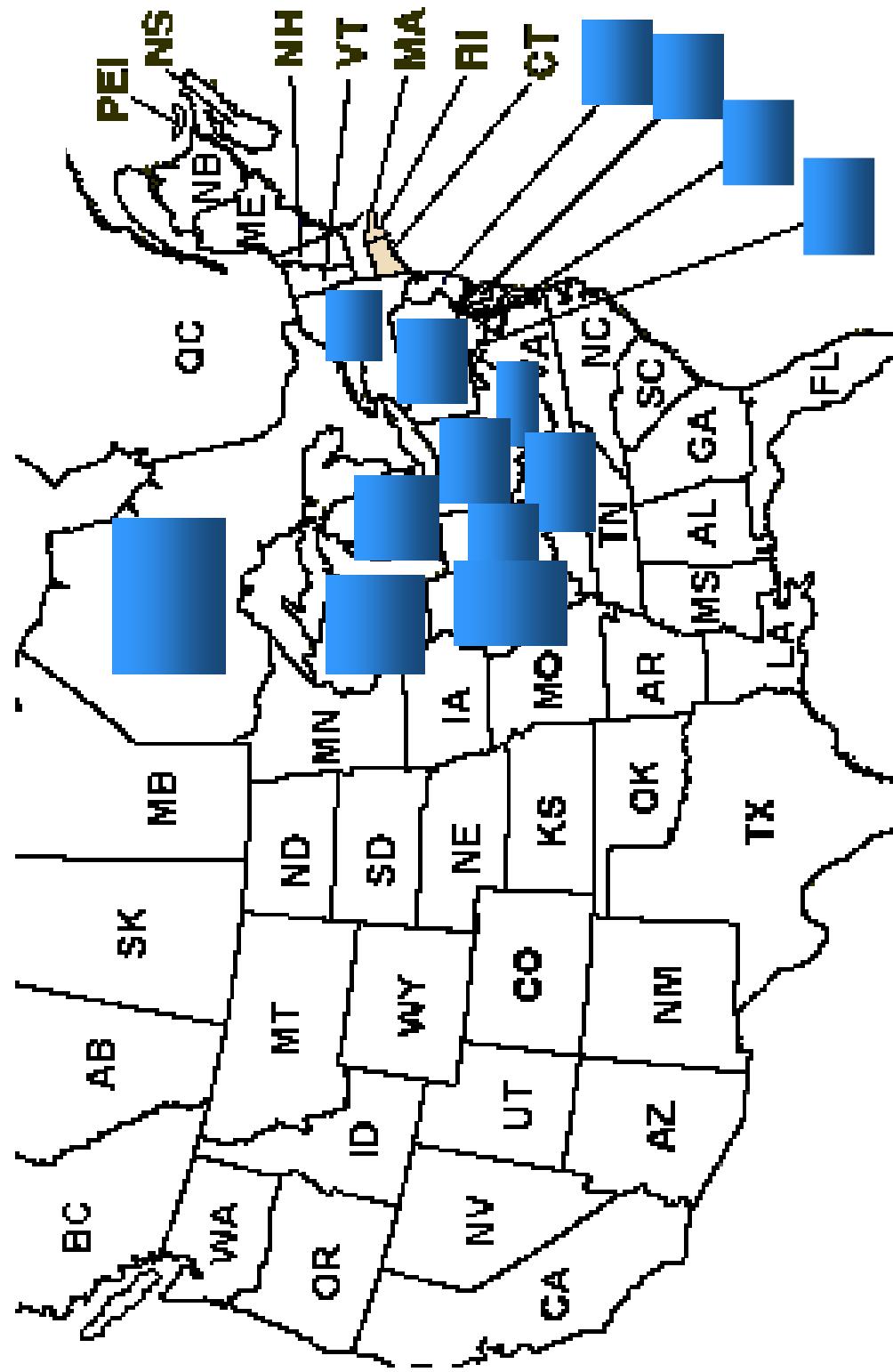


- The MOE defines an air shed that is believed to affect air quality in the province. This area is called the Ontario Credit Eligibility Zone.
- As it will be explained later, any entity that voluntarily reduces their emissions within this zone is eligible for NOx/SO₂ emission reduction credits (ERCS).
- The Zone includes Ontario, District of Columbia and 12 other states.



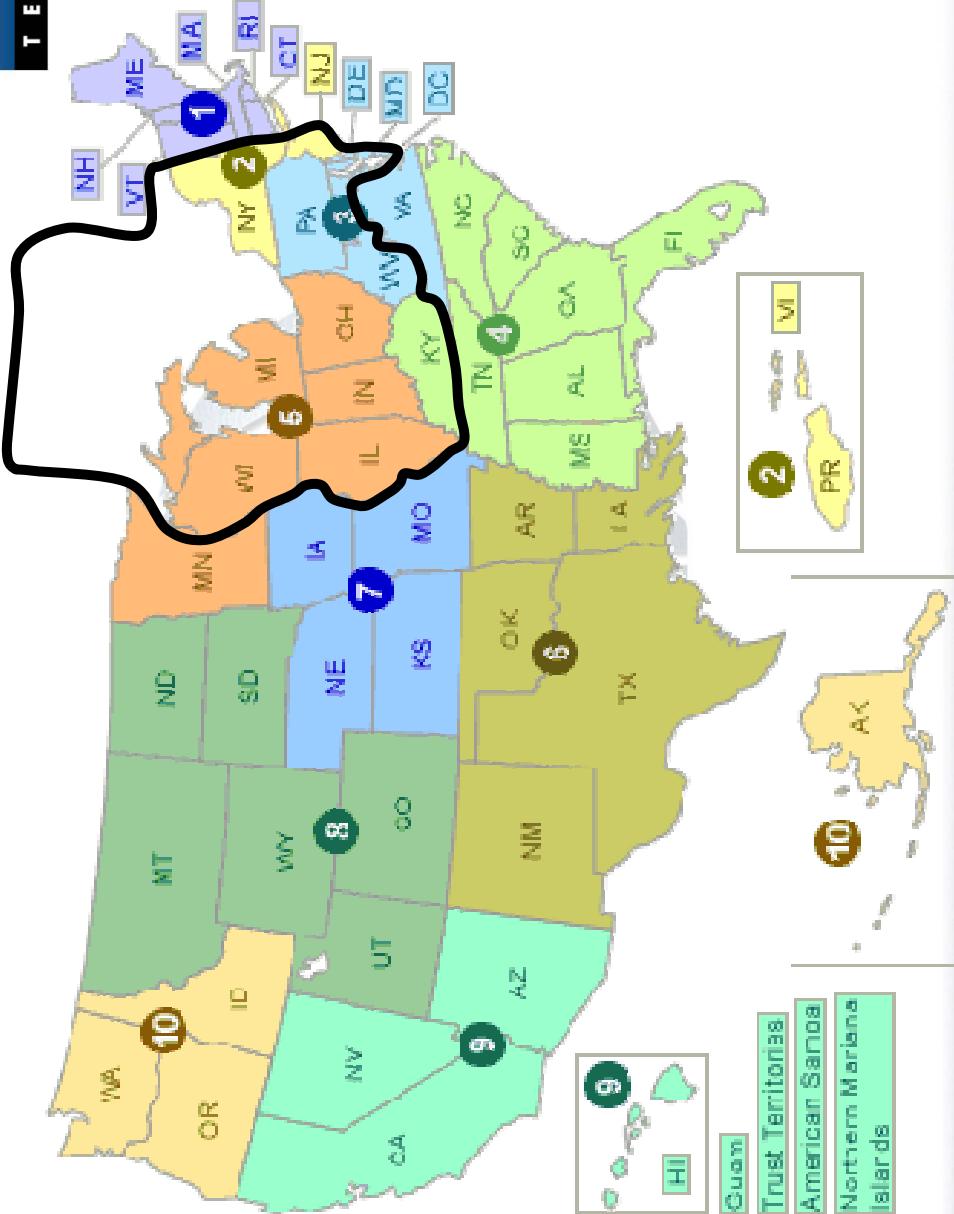
Ontario Credit Eligibility Zone

(Shaded Jurisdictions)



EPA Regions

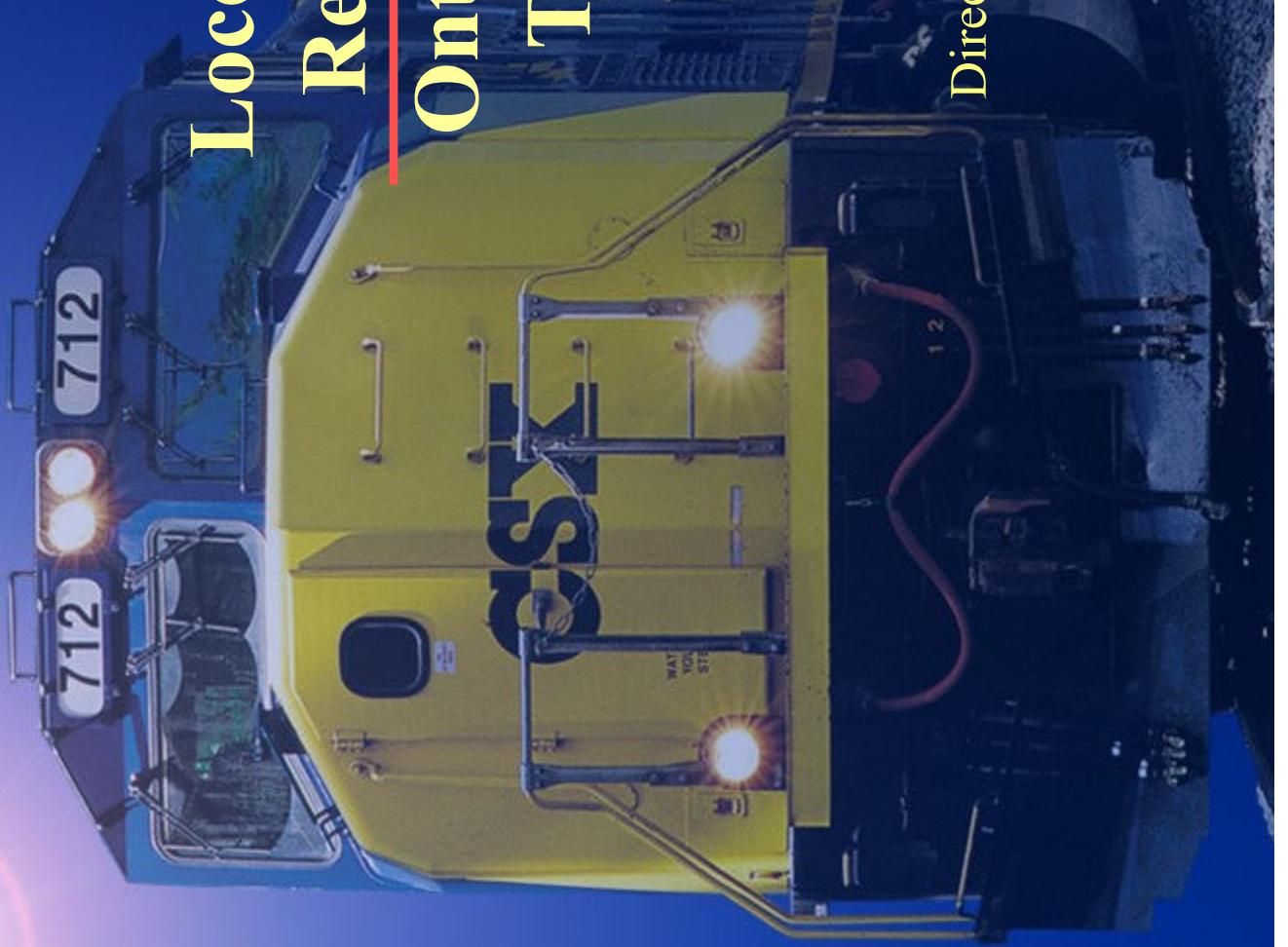
Ontario Credit
Eligibility Zone



Win-Win Deal

- Ecotrans Technologies is a proponent of emission reduction projects that involve locomotive idle reduction systems in the Ontario Emissions Trading program.
- By participating in the Ontario Emissions Trading, railroads can actually generate income through environmental initiative, in addition to fuel savings and improved public image.





Locomotive Emission Reduction Credits

Ontario's Emissions Trading System

Presented by:

Carl A. Gerhardstein
Director of Environmental Systems
CSX Transportation, Inc.

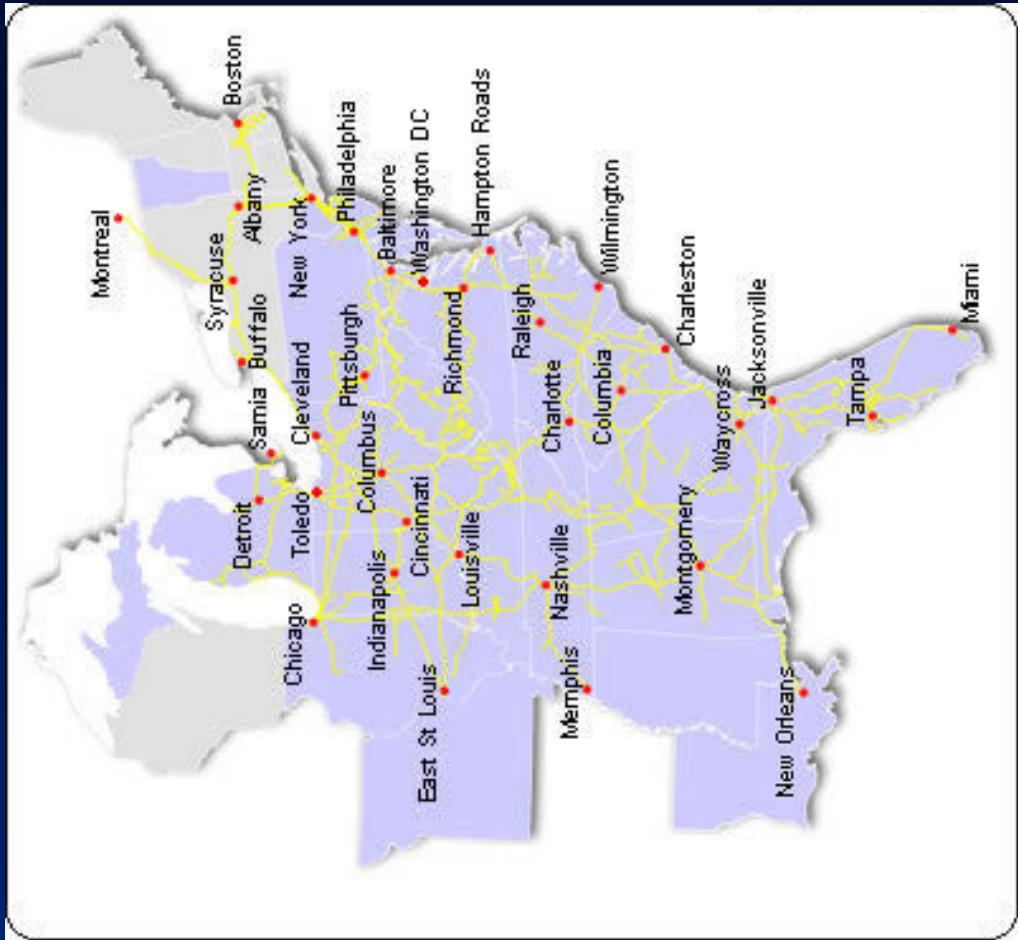
Outline

- **Introduction to CSX Transportation**
- **Emissions Trading in Ontario**
- **How does it work?**
- **Emission Reduction Credits (ERCs)**
- **Ontario Credits Eligibility Zone**
- **Registering ERCS**
- **Overall Benefits**



CSX Transportation in America

- CSX Serves 23 states, the District of Columbia and two Canadian provinces
- Over 21,000 miles of rail network.
- Over 34,000 employees
- CSX Transports:
 - Coal
 - Automotive
 - Chemicals
 - Grain and Agriculture
 - Metals
 - Paper and Industrial Products



CSX in Michigan

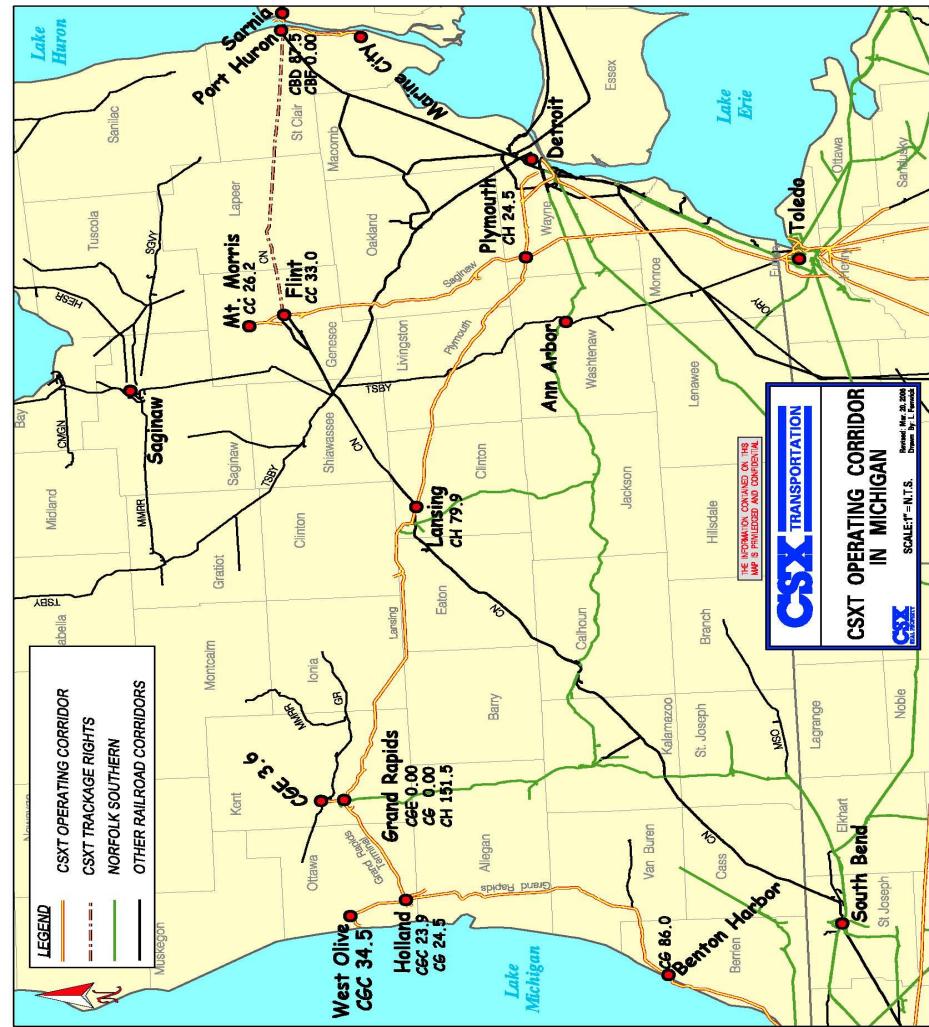
CSX impact

Products Shipped in Michigan include:

- Coal
- Automobiles
- Synthetic Fuel
- Iron and Steel

CSX Operations

- Operates over 600 miles of track
- Handles 186,000 carloads of freight annually
- Provides Service to over 300 industries
- Employs approx 800 residents



Ontario Emission Trading System

- Regulating via “the carrot or the stick”.
- Governed by Ontario Regulation 397/01, the emissions trading system allows capped emitters to “bank” or “trade” excess emission allowances, and...
- Non-capped emitters (e.g mobile sources) may earn credits for voluntary emission reductions. These ERCS can be sold to capped emitters under the program.
- The Ontario Scheme covers NOx and SO₂



Ontario Emission Trading System

- The Government of Ontario has set specific action plans to reduce air pollutants – specifically Nitrogen Oxide (NO_x) and Sulfur Dioxide (SO₂).
- Emissions Trading offers incentives to broad constituency to reduce air pollution
- Emissions Trading is a market-based tool with the broadest reach. It accommodates:
 - Investment cycles
 - Technology changes
 - Product use
 - International boundaries
- Trading can reduce dependence on regulatory actions
- Precursor to international GHG emission trading



Ontario Emission Trading System

How does it Work?

- System recognizes technology based reductions –7yr.
- The Ontario Ministry of Environment (MOE) sets an annual emission target (cap) for a particular plant/industry (determines demand).
- The credits must be earned within the Ontario Credit Eligibility Zone and must meet the following criteria:
 - Real
 - Surplus (Additional)
 - Unique
 - Verifiable
 - Quantifiable



Essential Elements

- Standard Methods – Basis for Protocol
 - A.6 *Standard Method for Emission Reductions Generated from the Installation of an Idle Reduction System (IRS)*
- Protocol – Describes how emission are achieved, and how quantified
- Verification – Recognition by Province
- Registry – Private Sector



Steps Necessary to Earn Credits

- Submit a Standard Method in accordance with Ontario Regs. 397
 - = Approval by the Ontario Ministry of the Environment (MOE)
 - = Approved by the Director of the Air Quality Branch.
- The Standard Method must then be posted for public scrutiny and comment.
- Standard Method signed by the Minister – (becomes law)
- Submit a Notice of Intent to create ERC's.
- Submit Protocol necessary to achieve ERC's in accordance with the Standard Method and the Notice of Intent to create ERC's.
- Submit for approval the evidence to support the ERC.
- Submit a verification report by an independent third party.
- The MOE scrutinizes the evidence of the ERC and posts its findings.
- Following the posting period, the Director approves the ERC and posts the earning and allows for the proponent to bank and/or sell the ERC.



From: operator@oetr.on.ca
Sent: Monday, December 05, 2005 11:42 AM
To: Gerhardstein, Carl
Subject: oetr.on.ca - Notice of Creation



Dear Carl Gerhardstein,

Facility: CSX Transportation, Inc.
Account Number: N_2005_97
Address: 500 Water Street, Suite J-275, Jacksonville, FLORIDA - 32202 USA

Subject :- oetr.on.ca - Notice of Creation

Thank you for the credit application named Phase7_ER1 and submitted on 03-NOV-05. Upon review, the Director has awarded the following Emission Reduction Credits :-

Pollutant	Season	Credits
NO	SMOG	11
NO	NON SMOG	10
SO2	ANNUAL	1

Your registry account has been updated. If you have any questions, please don't hesitate to contact the registry operator at operator@oetr.on.ca.
Sincerely,

Director
Ministry of Environment
<http://www.oetr.on.ca>

Baseline Emissions Determination

- Idle emission rates vary depending on the locomotive model, engine type and fuel properties.
- Baseline emission rates for locomotives are based on two reports:
 - Influence of Duty Cycles and Fleet Profile on Emissions from Locomotives in Canada, Transport Canada, by Robert Dunn and Peter Eggleton 2002
 - Locomotive Emission Study California Air Resources Board, by Booz-Allen & Hamilton in January 1991



Locomotive Idle Reduction Example

- Baseline locomotive idle emission rates:
 - = NOX (expressed as Nitrogen Dioxide NO₂): 1016 g/hr
 - = Sulfur dioxide SO₂ (based on 0.2 wt% Sulfur): 63 g/h
- The main engine shut down for one hour and the APU Locomotive Idle Reduction System started which has the following emission rates, (based on average loading):
 - = NOX (expressed as NO₂): 55 g/hr
 - = Sulfur dioxide (based on 0.2 wt% S): 9 g/hr
- The hourly emission reductions are:
 - = nitric oxide: (1016 - 55) = 961g
 - = sulfur dioxide: (63 - 9) = 54g

Average 961 – 1361 grams of NOx
reduced for every hour of shutdown



Locomotive Idle Reduction Example

- Locomotive idling data logged via automatic data logging and satellite communication. This data are used to calculate ERCS
- Locomotives, typically idle 40-60% of the time the main engine is in operation, which equates to about 8 -14 hours per day. Railroad operating policies, automatic shutdown devices and layover protection systems have all been developed to reduce main engine idling and each of these systems can have an effect of reducing idle time to some degree.
- Potential to generate several tons NOx/locomotive/year



Who are the Consumers of Credits?

- Electric power sector (Ontario Power Generation has the lion's share)
- Recently capped Sectors (late 2005)
 - = Iron and Steel
 - = Cement
 - = Petroleum Refining
 - = Pulp and Paper
 - = Glass
 - = Carbon Black



Overall Benefits

- Credits based on past performance
- Fuel savings
- Improving air quality
- Contributing towards sustainable development
- Enhance company's public image
- Demonstrate environmental leadership and initiative

